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Technology in Laboratory Teaching: Expansion of Classroom Education through YouTube

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Technology in Laboratory Teaching: Expansion of Classroom Education through YouTube

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ABSTRACT

The increasing popularity of social media has made it possible for all manner of people to upload personal videos on the internet to be viewed by anyone free of charge. If used appropriately, useful material can be given to those that willingly seek it out. This project focused on uploading biology related laboratory technique videos on YouTube in order to reach a larger audience; providing assistance to students outside of WPI. Monitoring the usefulness of uploading videos was done by collecting the number of hits and comments the videos received. Based on the limited results it was determined that the videos were useful by providing technical help to students and professors and that YouTube can be used as good source of educational material.

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Introduction

Social networks have slowly been transitioning from teen oriented sites to communication and information pathways used by schools and businesses (Wright, 2009). People are so obsessed with technology that it's incorporated into everyday lives; mostly seen as people buried in their cells phones, whether it be texting, checking e-mail, or updating their status on Facebook. This advancement in communication based technology does come with its upsides, especially in school settings. The goal of this project was to use YouTube as a gateway to provide educational information, which is otherwise solely found in the university science laboratory, to everyone. The subject matter is exclusively biology related, dealing with the various techniques and equipment used in a biology laboratory.

Placing any form of media on a public website does come with some issues that need to be dealt with such as the content being shown and who it might offend, copyright issues and the like. The most important issue is to determine if uploading this material is actually worth the effort; will any of the videos be viewed and if so will it be for educational purposes? To decide if it is worth uploading lecture/school based material, the biology videos were placed on YouTube and allowed to collect comments over the months June-November. If the videos are worthwhile then there should be positive comments relating to their usefulness.

Media Used in the Classroom

The method in which information is delivered from teacher to student has gone through a great deal of changes. Students traditionally had just the teacher, a text, and the chalk board to supply any educational information. As technology made advances so did the method of information delivery. Before long, teachers made use of slides and film strips which not only provided educational material but presented it in a more interesting manner; students are more likely to retain information if it is provided in a manner which interests them (Warschauer, Turbee, and Roberts, 1996). From this evolved television shows and movies shown via VHS; this allowed students to visualize things now instead of observing static pictures in a text book. Soon PowerPoint slide shows and DVDs were used. Eventually with the birth of the internet, teachers had an endless pool of information to provide to students; and students no longer had to solely rely on the teacher (Dutton, 2001).

Changing from the teacher as the sole source of instruction to the internet where anything and everything can be found decreased the weight on the teachers and allowed the students to be a little more independent. Students are now able to find out information more easily without relying as much on professors (Lents and Cifuentes, 2009). Teachers and professors will always be the main source of educational information, but their lectures used in tandem with the internet or web sources of educational value provides an enhanced form of learning (Lents and Cifuentes, 2009).

There are several accounts of YouTube videos being used as a supplemental teaching tool. One such instance was with a college health class, where videos based on

drunk driving were shown to the students to show them the dangers of such actions. Feedback from the students was very positive, stating that: “This speaks to students our age, and high school students will get this too” (Akagi, 2008). This health class study, carried out by the University of Kansas, used YouTube as a source of information, taking videos that were already uploaded and using them in the classroom (Akagi, 2008).

There is another account from Jerry Everhart from Eastern New Mexico University who has also incorporated YouTube into his class curriculum. Professor Everhart uses videos already on YouTube and also creates some of his own that deal with the topics he teaches his students. There are two main points Professor Everhart makes in his discussion about his newly enhanced method of teaching. The first is the increased engagement he noticed in his students and their willingness to learn and study. Seeing as how most students are very technology adept, they find it interesting and fun to use YouTube as a means of learning (Everhart, 2010). The second point Everhart makes is the ease to edit videos. If an error was made or there happens to be an update he wishes to make to a lesson plan, he can easily edit the video to accommodate changes that were made (Everhart, 2010). Using YouTube as an external source of information or as a tool for students to use outside the classroom setting has been shown to be very beneficial.

Possible Complications

As mentioned before there are a few complications that arise when posting videos online for anyone to access. One issue that is of major concern to many

universities is the free access to education that was previously exclusive to that school. Some administrators feel that they're losing out on money that they would otherwise receive by enrolling a student into the class, because with the class lectures online there is no need to enroll (Young, 2010, pg 1-5). MIT has taken a different approach and actually posted its material online for free. Their website known as MIT's OpenCourseWare provides almost all the content that is given to undergraduate and graduate students at the school to the general public; posted content includes lecture notes, exams, and even videos. The catch is one cannot obtain a degree by mastering all the material that is posted; it is purely a source of information free to the public to enhance learning ("MIT OpenCourseWare"). This project hopes to accomplish something similar but instead of posting WPI's entire curriculum, only biology related technique videos will be posted that would be useful to those enrolled in a similar class or to be used as a teaching tool. The videos are not meant to be substitutes for classes but as additional sources of information to assist others.

In a related issue, the content itself must also be under consideration. It is likely that the videos being posted from a university will mention itself either in the video or in the description, which would make it responsible for all posted content. It is essential that all content is screened to make sure there is nothing offensive, which would come back on the school and become a legal issue or bad publicity (Young, 2010, pg 1-5). Copyright infringement can also bring legal problems to any content posted online, whether it is from a school or otherwise. Schools are granted special permission to use and distribute copyrighted material within the classroom; this is considered "fair use"

and is covered under section 107 of the copyright law ("Fair Use"). This protection is lost once a school posts things online without permission of the original owner. As with the above concerns, it is absolutely necessary that the content is carefully screened for material that does not belong to the school or any material which may end in a lawsuit (Young, 2010).

Even with all of these potential hazards, it is still worth placing videos online to be used as teaching aids for students and teachers. It can provide assistance in helping a student decide what they want to major in; and based off this project, the videos offer a source of technical aid for students to improve upon their laboratory techniques. This eventually leads to the creation of a free knowledge exchange community where people of all professions can offer opinions and insight about their areas of expertise. This is especially useful in the science and technology fields where professionals can share their ideas which could aid in the development of future technologies and discoveries (Spree: the knowledge exchange network).

In reference to the content of the videos specific to this study, they offer a preview to students that are about to perform a particular laboratory technique which can prepare them before such a technique is carried out. Instead of blindly attending a lab exercise and seeing everything (equipment, procedures…) for the first time, the video can be viewed to get the student more familiar with what they will soon be doing.

A study similar to this was performed by students at WPI who had the task of creating the videos that are now being posted to YouTube. After creating the videos, they were circulated among the WPI student body and data was collected via surveys

which were related to the video content and its usefulness. It was determined that the videos did in fact help students in understanding and retaining information which would have otherwise not occurred with just a standard lecture (Forte, Tyagi, Vercillo, and Walsh, 2009). By posting these videos online, we offer this particular type of aid to all students and not just those attending WPI. The goal is to provide help to those that are in need and know how to use the internet to search for such material.

Materials and Methods

Uploading on YouTube

The videos were already within the WPI database; a previous project was based on the creation and editing of the biology videos (Forte, Tyagi, Vercillo, and Walsh, 2009). The videos were uploaded directly to WPI's YouTube account via the localized WPI database; this is easily done using YouTube's uploading interface. Once in the YouTube account, the upload button was clicked which loaded the uploading video page. Clicking the yellow upload video button allowed the computer to be searched for the videos of interest. Once a video was chosen the uploading process began, during which the video was described appropriately in the description area that accompanies each video on YouTube. It was important to give the videos titles that would be easily understood when searched for; in addition certain tags were added to each video that would allow for it to appear should someone search for one of the keywords. All of the 2000 level biology related videos were uploaded with the exception of the dissection videos; 46 videos uploaded in total.

Editing Videos

YouTube comes with some minor editing tools for each of the videos uploaded. One of the tools used was the annotation feature, which allowed dialogue boxes and links to related videos to be added in the video. These were placed on just a few videos to see if they provided any usefulness. They were mainly used to tie together videos

that extended beyond just one video, such as the three Transformation Lab videos and the animal behavior labs.

Data Collection

To determine if the videos were achieving the goals of the project, the comments and number of views were collected. In each video's description was a message to the viewer to leave a comment or suggestion about the video. The number of views and comments are found on each video's page; to collect the data, each video had to be accessed through YouTube and the data manually collected. The number of views for each video was recorded; videos with comments near 1000 views or more were considered a success. The views were compared among the videos in the project and not the number of views any other video might have on YouTube. The views ranged from 14 to 4156. Videos with 1000 or more views considered popular/very useful, those between 400-1000 were considered of average usefulness, and those less than 400 considered to have little usefulness. Comments were collected from any video that had them. Currently there is no way of massing the comments or easily collecting them from each video, instead they were copied from each individual video; comments are posted under the video.

Results

The goal of this project was to provide technical assistance to a wide range of people; focusing the video content on biology related laboratory techniques. The idea was to take the laboratory techniques that were previously exclusive to the WPI biology Laboratory and upload them to YouTube to allow all to use it as a source for educational gain. Each video was put into a category that best represented their content and then compared to one another based on the number of views for each. The videos were congregated into a total of six groups: 1) Assays/Purification Techniques; 2) WPI Oriented labs;3) Bacteria/ Animal Cell stains; 4) Lab techniques; 5) Lab Equipment usage; 6) Animal Observation/Survivorship; views were collected from May 6th 2010 to November 25th 2010. Figure 1 is the data for all the videos related to the proper operation of lab equipment. These videos don't include all of the pieces of equipment that are used in a lab but some of the more general ones. Of all the videos, the microscope, spectrophotometer, and table top centrifuge appeared to be the most useful; the other videos had far fewer views.

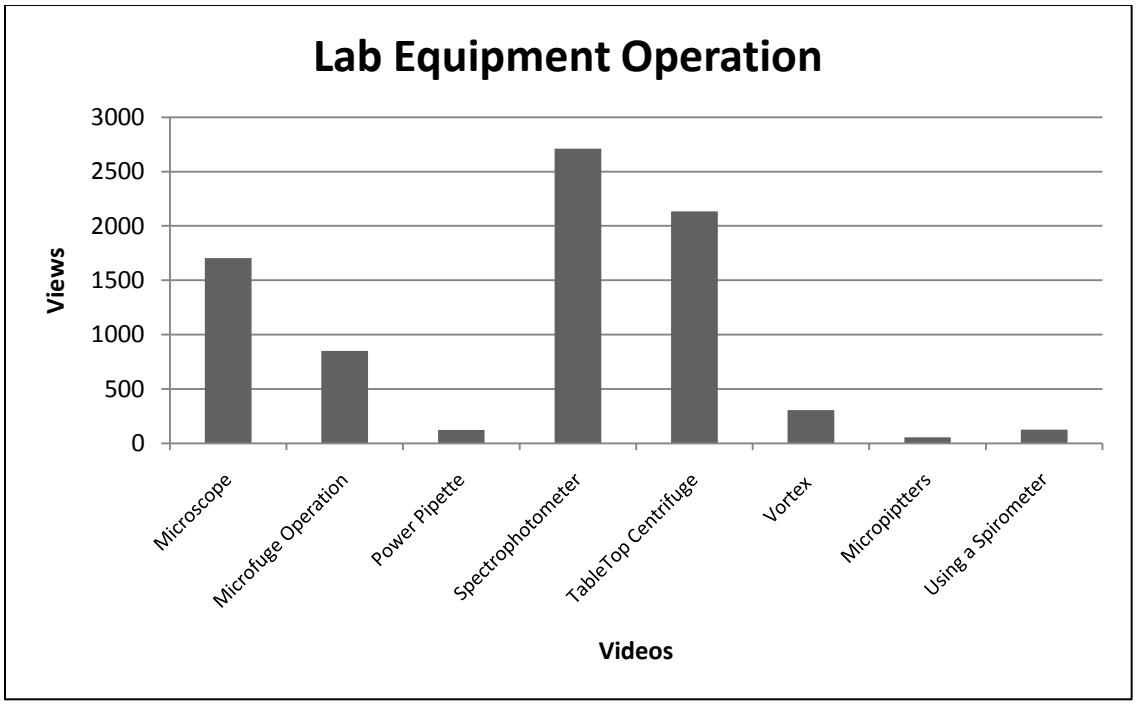

Figure 1: Lab Equipment Videos - The number of views for all of the lab equipment based videos.

The next set of videos that were analyzed was the WPI Oriented labs. While all of the videos were based on WPI laboratory protocols these videos were very specific to these protocols, however they offered enough general knowledge that they were deemed useful enough to post on YouTube. Some of the videos consisted of multiple parts, such as the bacterial transformation and restriction digest videos. Others made use of protocols to teach analytical techniques, however they were much too specific to WPI to be grouped with the other assay videos. Figure 2 shows the number of views that each of these videos received. Only three of the videos were viewed over one thousand times, the others maintained in the low hundreds; three videos did not go beyond one hundred views. Two videos related to Bacterial Transformation and one based on a pH alteration were the videos most viewed.

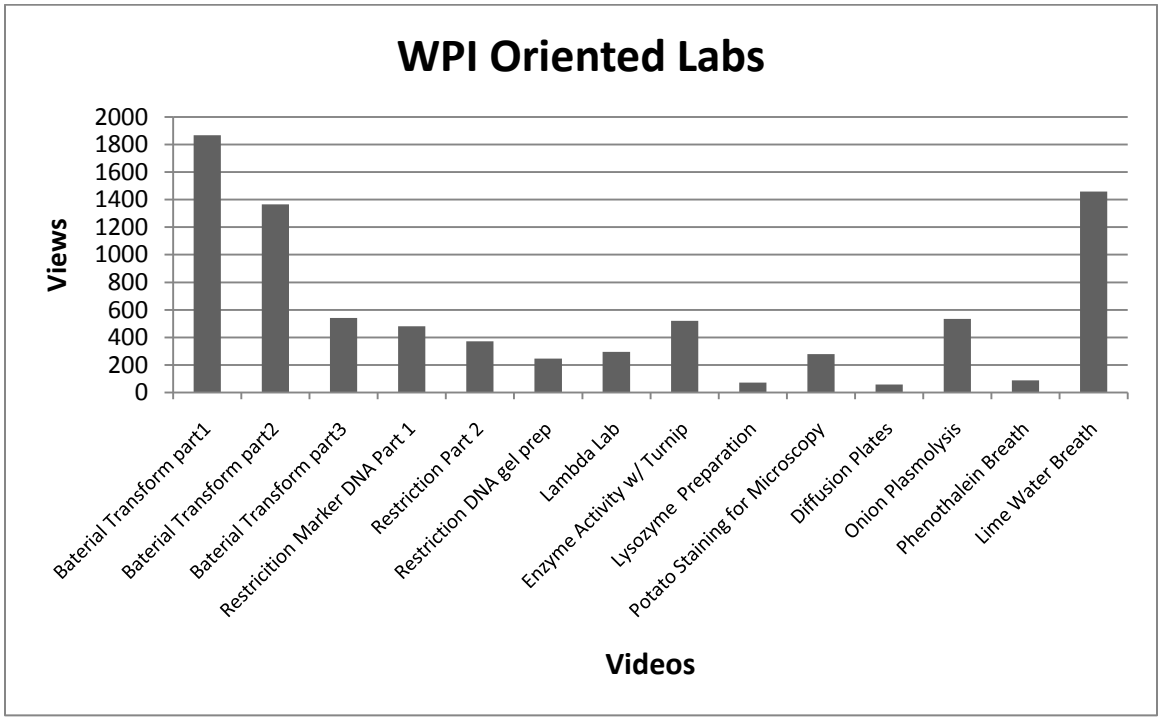

Figure 2: WPI Lab Oriented Videos - Each of the videos in this group were heavily focused on WPI protocols given to the students. Each still had enough general information that inspiring students could find useful.

The Bacterial Staining videos were the most popular of the uploaded videos (Figure 3). These types of experiments are relatively easy to perform so the method of execution remains similar in all labs. The only video to do poorly in views was the squamous cell staining video, with only 169 views. Each of the stains related to specifically bacteria had more than one thousand views each; the gram stain video was viewed over four thousand times.

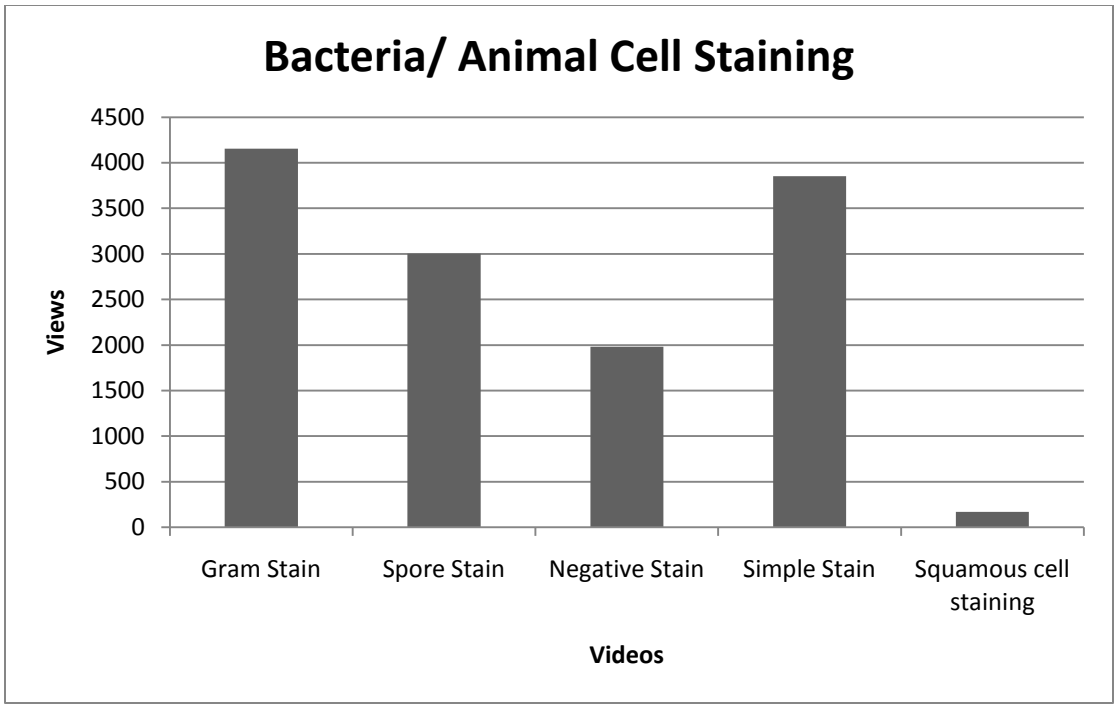

Figure 3: Cell Staining Videos - Videos related to cell staining for observation. All but the squamous cell video had a large number of views; bacterial videos were watched more than all other videos that were uploaded.

Among the uploaded videos was a group that involved analytical methods that were employed during a few of the labs. Like the cell staining videos, these offer general protocols that most labs follow. Two assay videos, ELISA and Bradford, and a protein purification video proved to be of interest to the viewers, with views in the thousands (Figure 4). The column chromatography video did not appear to be of much interest when compared to the others; even though the protein purification with dialysis tubing video is in an extension of such a technique.

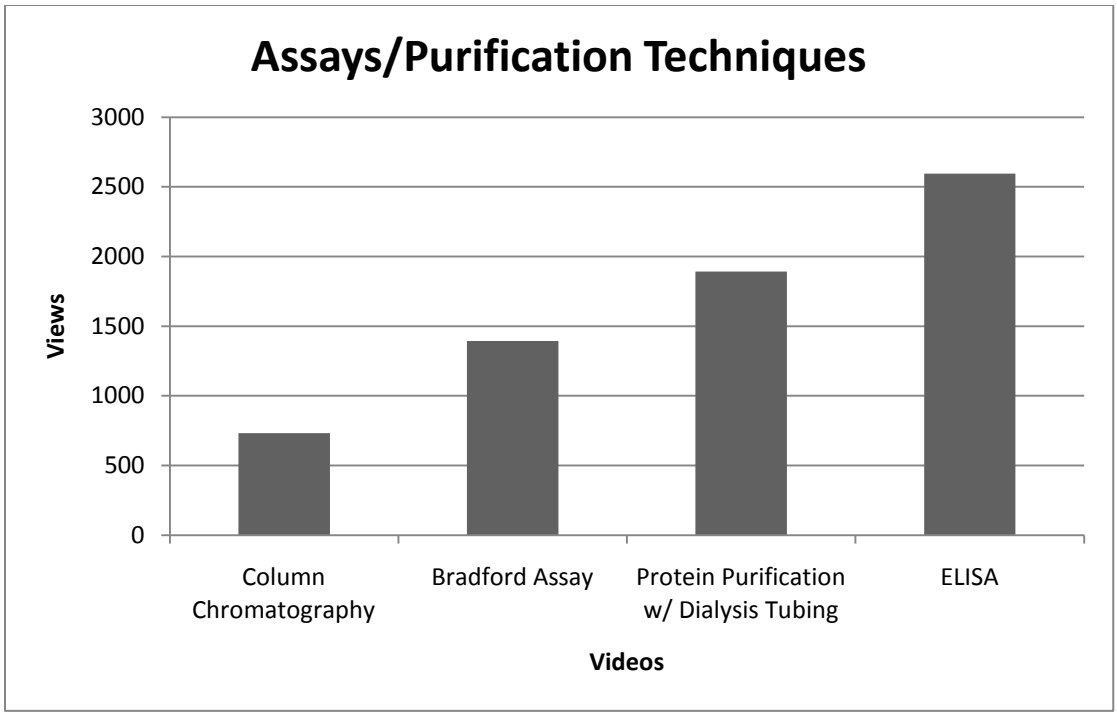

Figure 4: Analytical Videos - Videos based on analytical methods employed in a laboratory setting.

There was another grouping of videos that were more focused on lab techniques and safety. These were based on routine tasks that a lab technician would normally endure during experimentation (Figure 5). The videos were mostly based on how to dilute reagents and pouring multiple types of gels. Out of all the videos, only the serial dilution video was viewed over a thousand times. The others measured in the hundreds and below; even the 10-fold serial dilution video was dwarfed in comparison to its counterpart.

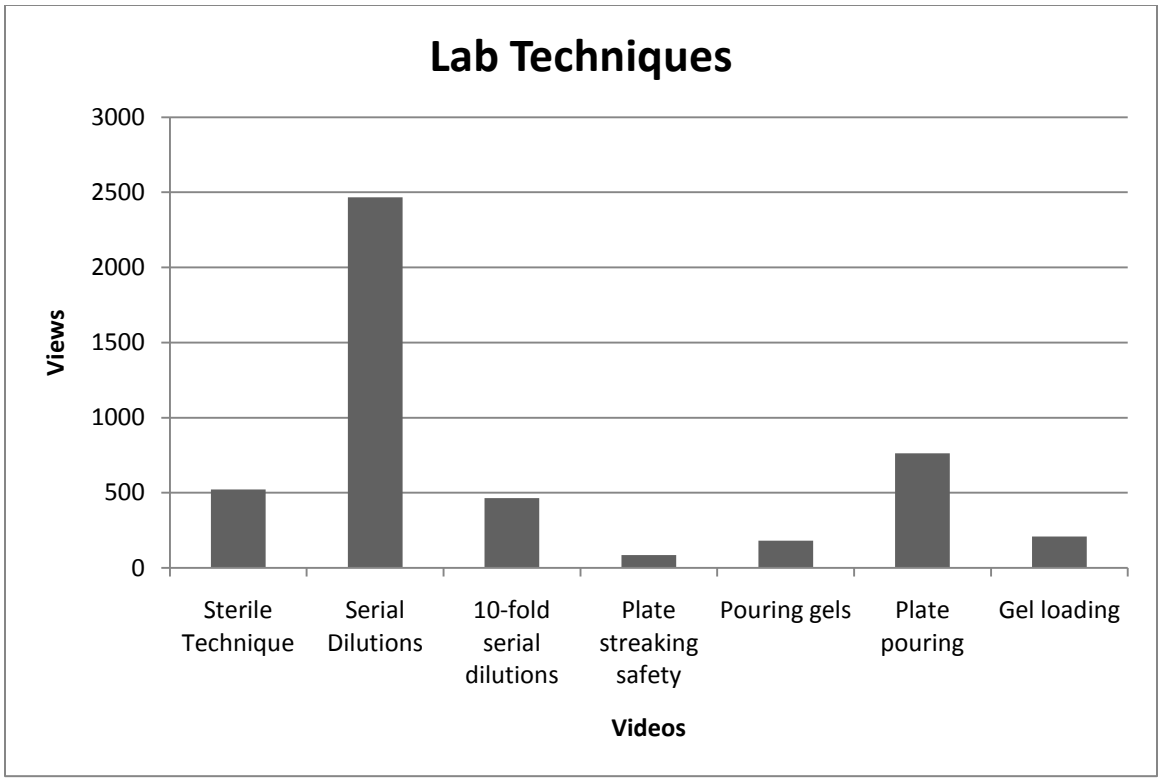

Figure 5: Lab Techniques - Videos based on simple tasks that most technicians should learn as second nature.

The last group to be analyzed was the Animal Observation and Survivorship videos. Some of the experiments involving animal observation also dealt with understanding the concept of survivorship. While each video appeared to have a large number of views (Figure 6), they were only viewed under two hundred times. These are similar to the WPI Oriented Labs due to their heavy focus on WPI protocols; however their content focused more on animal characteristics.

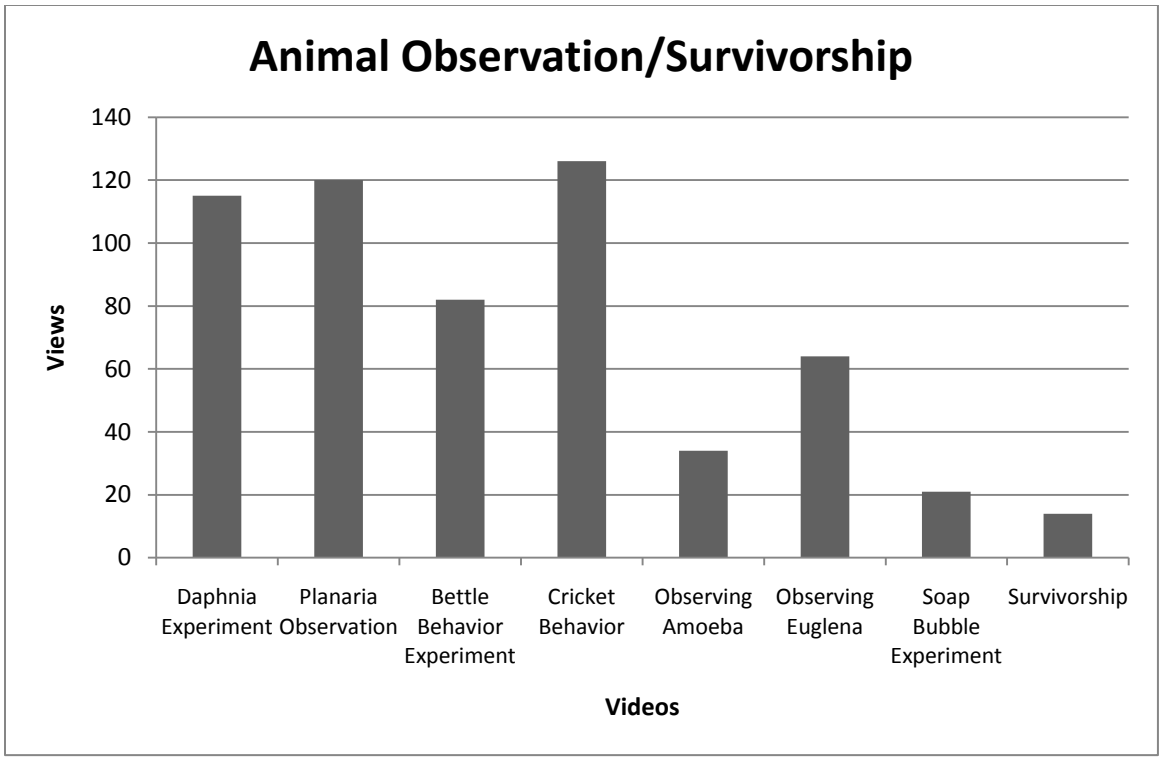

Figure 6: Animal Behavior - Number of views for videos with animal behavior and survivorship content. Overall results very low, with only three videos breaking one hundred views. Max number of views was only 126.

Recording the number of views was one way to determine the usefulness of each video, but it did not allow for personal opinion. Four thousand people may have watched the Gram Stain video but did they all find it worth viewing? To get a better understanding of each video's worth the comments were collected and read. Unfortunately, only eight of the forty six videos had comments; and of those eight videos the comments numbered between one to four per video (Table 1). Leaving comments on a video is optional, so a message was left in each video's description box asking the viewer to leave suggestions or feedback. Appendix I shows all of the collected comments as of November 25th 2010; the comments are organized by video. Most of the comments were positive stating that the particular video helped in carrying out an

experiment or preparing for class. The Gram Stain video was even used for an in class demonstration (Appendix). Other comments pointed out where a video was confusing. For example, one comment was left on the Spore Stain video stating that some explanation would be appreciated as far as what stain is being used in what order and why they are used. There were three comments that did not offer any help at all and had no connection to the video content. One person in particular was confused about the outcome of the Cricket Behavior video, wondering if the male cricket allowed a second female to enter its territory (Appendix I). One important correlation to notice is that of all the videos that had comments, a majority of them also had very large number of views (Table 1).

Video Title	Number of Comments	Number of Views
Bacterial Trans. Part 1	2	1867
Gram Stain	4	4156
Spore Stain	2	3002
Table Top Centrifuge	1	2135
Microfuge Operation	1	850
ELISA	2	2595
Enzyme Activity/Turnip	1	521
Cricket Behavior	2	129

Table 1: Comments and Views Comparison - Just 8 videos had comments, and the comments were very few. Each video is compared based on content, views, and comments.

Discussion

The goal of this project was to provide educational scientific material to the general public and then obtain feedback which would determine the usefulness of providing free educational material. This was achieved by placing videos with educational content on YouTube in the hopes that those looking for help will search online; should they choose this option our uploaded videos will give them the help they need. Videos were uploaded on YouTube in May of 2010 and were available for viewing and comments until November 2010. This did not provide a large number of comments that could be used to come to a concrete conclusion; however, the majority of comments were positive which points toward a successful endeavor in terms of this project.

The first way to justify uploading videos on this particular content was to examine the views each of the videos received. Again, their usefulness was gauged based on view numbers, with those having 1000 views or more to be considered very useful. This isn't to say that those with much fewer views were useless; only that they were not as helpful to a wider population of people.

The first group examined was videos related to lab equipment operation. These had about four videos that did really well in terms of number of views, while the others remained unpopular (Figure 1). It seems as though the most popular videos were related to pieces of equipment that are used in high school settings: microscopes, centrifuges, and spectrophotometers. At this point it is impossible to tell which age

group was watching the video; devising a plan in the future to discover which age group watches which video could be very beneficial in the editing/uploading process. Two of the videos from this group received comments; the Table Top Centrifuge and Microfuge Operation. The Table Top comment was positive, only suggesting that the video should be longer. The other video received a comment that just had a link to the same video. This is one of the setbacks when using a site that is open to the general public, sometimes people leave random comments that are of no importance.

One group of videos was particularly unpopular, the group relating to WPI Lab Protocols (Figure 2). Three of these videos had over one thousand views; the others were 500 and less. While 500 views for a video is still a good number, it is small in comparison to some of the more popular ones in this project. Part of the reason for the average number of views could be due to the specificity of the videos; these are created specifically for WPI students and unless there is a student working on a similar exercise the chance of someone looking for it is slim. There was one particular video that had about 1400 views, the Lime Water Breath experiment. Its popularity is most likely due to its “fun” factor; appearing more of a magic trick than a science experiment. Two of these videos also had comments: Bacterial Transformation Part 1 and the Enzyme Activity with Turnip. The comments for the Transformation video were both positive, expressing how helpful the video was. The comment for the Turnip video was making a correction that the narrator had made about one of the reagents being used. All of these comments are beneficial because they point out the usefulness of the videos and at the same time let us know that there are some improvements to be made.

The next group was the most popular out of all the uploaded videos; the Bacterial/Animal Cell Staining group (Figure 3). It was the videos about bacteria that had the largest number of views; the one mammalian cell video did very poorly. In this case a possible connection could be made between number of views and the comments. In the comments section of the Gram Stain video a user had said that they use the video in their 7th grade class. It's quite possible that the students then went to this video and watched it to prepare for class or even during the lab itself. As to why the other videos did so well it can only be speculated upon. It may be due to the use of the Gram Stain in the 7th grade class and those students continued to watch related videos, which would include the bacterial staining videos.

Another popular group was the Assay/Purification Technique videos (Figure 4) with each video having a large number of views. The reason behind their popularity is difficult to determine. Their content is not similar to the staining videos and they don't have ties with WPI protocols. The videos are popular analytical techniques which may be confusing to students and posting them online allowed the students to find some help. From personal experience the first time using these techniques was a bit difficult and viewing the videos made them easier to comprehend and execute; the same problem may happen to many students.

There was another set of videos that appeared to have a mixed review to YouTube users; the Lab Techniques group (Figure 5). The Serial Dilutions video did really well with almost 2500 views. This made sense because this particular technique is used often in a laboratory setting. What is interesting is how less frequently the 10-fold serial

dilutions video was viewed. A possible explanation is viewers may be searching for serial dilution in general and not looking specifically for a 10-fold dilution, which would lead to the larger number of views. Properly tagging videos was in important aspect of the project. The tags are keywords that when searched for by a YouTube user will make the video more likely to appear in their search. The serial dilution video was general enough to appear frequently should a user attempt to look for a dilution video.

The last group analyzed was the Animal Observation set (Figure 6), which was the least watched group of all the videos. It is assumed that these may be too specific to WPI students to offer help to others. However, even those from the WPI Protocols were viewed more than these videos. A possible reason would be the particular type of experiments carried out in these videos, they may not be experiments that are tasked to a lot of students; this would cause a low number of searches and views. One of the videos from this group received comments, the Cricket Behavior video. Both of the comments were by the same user who wanted to know the final outcome of the experiment. The user failed to understand that this video was to show how to carry out the experiment and that the question they were looking for was something the person executing the experiment was supposed to discover on their own. It's difficult to determine if this means the video needs editing. It may be misleading because during the course of the video, the experiment is being shown step by step until the conclusion. In the future it may be a good idea to explain that the videos are meant to enhance learning and not provide the answers to experiments.

Even though there were 14 videos that were very popular and most of the comments were positive there could be a few improvements. Some of the videos could use editing, mostly removing content that is geared toward WPI students and leaving in the general protocol items. Some videos could be reshot completely due to some users wishing to see more. One comment on the Table Top Centrifuged wished the video was longer. If these videos are to remain on YouTube it would be worth editing the videos to cater to the users wishes.

One of the bigger problems with collecting data for this study was the lack of comments that the videos received; this is due to the poor advertisement of the videos. Currently the only way for people to find these videos is to expect they can search for this type of content on YouTube. If some sort of advertising was used that could let students or other people know that this type of content is on YouTube maybe they would have more views. This isn't to say that what was accomplished here was unworthy; the fact that some videos were viewed thousands of times proves their worth.

There also needs to be another way to entice viewers to leave feedback. At the moment the only way the viewer would leave feedback is if they wanted to or they happened to expand the description box and see that they were asked to leave a suggestion. This could go back to some minor editing of the videos, maybe adding an annotation at the end that asks viewers to leave comments. Another solution is to add a link at the end of the video that directs the viewer to a survey page were more detailed information could be gathered about the video; questions relating to the content of the video and the age and education level of the viewer.

Despite the small number of comments, the overall positive feedback led to the conclusion that the project was a success. This was the first attempt made by WPI to use YouTube as a teaching tool which was used to reach the general community. These videos were meant to be a useful resource for others and the data proved that this was accomplished. Judging from the positive results that were generated it seems that extending the project and continuing to upload educational type videos is worth the effort.

Appendix I

The following are comments that were collected from the uploaded videos that occurred from May 2010 to November 2010. These are copied directly from the YouTube comment section that is on every video's webpage. No alteration was made to the content of each comment only the format in which the user and comment is presented.

Bacterial Transformation- Plasmid Prep (Part 1) 1808 views

User: peppermintlook

> Thank you for this. I just wanted to see this. I'm preparing competent cells tomorrow and I really need the 10 power 8 efficiency. I guess this should help. Thank you. Bye

User: ipod9029

> thank you it was very beneficial. :)

Gram Stain

User: gsjj1

> such a great video...short straight to the point...and easy to understand...thanks guys!

User: naomilaboo

> Thanks now I know what I did wrong!

User: jholdenz4

> great video for in class demonstration before lecturing the details of gram stain and use of oil immersion for bacteria

User: jholdenz4

> great visual, concise and accurate - I use for 7th grade!

Spore Stain

User: ingridleon1

This was helpful in terms of technique, thank you. The quality was also really good and your pace was nice. It would have been nice if you would have explained that malachite green is the primary stian, the decolorizer water, etc. and how that is affecting the cell.

User: TheExPlOiTeDOne619

Thanks a lot, this will definitely help me out in microbio :).

Table top Centrifuge

User: taylorcp1956

Great video; wished it had been longer!

Microfuge +Centrifuge Operation

User: bmed19

3:00

ELISA

User: Noorawadh:

may I know what test is done by this ELISA experiment?

User: NIKUNJ84

Thanks for sharing this video... very helpful... -nIkunj

Enzyme Activity Using a Turnip

User: turen1234

25 milliMolar not microMolar, lols

Cricket Behavior

User: shreyasragunath

So did the male cricket accept the second female cricket into its territory?

User: shreyasragunath

What the conclusion please!

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